REMARKS/ARGUMENTS

Reconsideration of this application is requested. Claims 1-34 are in the case.

I. CLAIM OBJECTIONS

Claim 10 has been objected to in view of a spelling error. That has been corrected in the present response.

II. SPECIFICATION

The Abstract has been objected to as informal. In response, a new Abstract is presented on a separate sheet attached hereto.

A spelling error has been noted at page 5. This has been corrected in the present response.

Withdrawal of the objections to the Specification is now believed to be in order. Such action is respectfully requested.

III. THE PRIOR ART REJECTIONS

Claims 1, 2, 4, 6, 10-14, 18 and 19 stand rejected under 35 U.S.C. 103(a) as allegedly unpatentable over EP 0 430 915 A1 to Vaheri et al in view of WO 89/02951 to Bystedt. Claims 3 and 20 stand rejected under 35 U.S.C. 103(a) as allegedly unpatentable over Vaheri and Bystedt and further in view of WO 92/20855 to Falk et al. Claims 5 and 9 stand rejected under 35 U.S.C. 103(a) as allegedly unpatentable over Vaheri and Bystedt and further in view of U.S. Patent 4891096 to Akkawi. Claim 7 stands rejected under 35 U.S.C. 103(a) as allegedly unpatentable over Vaheri and

Bystedt and further in view of U.S. Patent 3,962,033 to Eriksson et al and U.S. Patent 5,203,964 to Call. Claim 8 stands rejected under 35 U.S.C. 103(a) as allegedly unpatentable over Vaheri and Bystedt and further in view of U.S. Patent 5,830,734 to Christgau et al. Claims 15-17 stand rejected under 35 U.S.C. 103(a) as allegedly unpatentable over Vaheri and Bystedt and further in view of Casey. Claim 21 stands rejected under 35 U.S.C. 102(b) as allegedly anticipated by or, in the alternative, under 35 U.S.C. 103(a) as allegedly unpatentable over Vaheri. Those rejections are respectfully traversed.

As now claimed, the invention provides a method of producing mechanical pulp. The method comprises initially compressing a fiber material, selectively weakening a pectin-enriched region in the fiber walls of the fiber material by impregnating fiber material with a pectinase-containing aqueous liquid resulting in hydrolysis of the pectins, and defibrating and refining the fiber material to produce a mechanical pulp.

A major problem associated with the production of mechanical pulp is high energy consumption. However, a primary advantage of mechanical pulp (also called high-yield pulp) is its high yield with a high utilization of the material, and thus it is important that any production process does not result in appreciable loss of yield.

It has now been found, according to the present invention, that a reduced energy consumption and an improved pulp quality can be attained upon refining with a limited loss of yield, by exposing the fibre material to an initial compression, followed by impregnation with an enzymatic pectinase-containing aqueous liquid to selectively weaken a pectin-enriched region in the fiber walls of the fiber material, and defibrating and refining the fiber material to produce the mechanical pulp. The examples of the

present application show that such a pectin-decomposing treatment results in surprising improvements in respect of both energy consumption and pulp quality, e.g. in terms of tensile strength and tear strength and optical properties such as brightness of bleached or unbleached pulp.

The initial compression step is an important aspect of the method in order to achieve the above-listed advantages of the present invention, by creating pores and contact surfaces for the pectinase to enter into the fiber walls where the pectin is. The art relied upon does not suggest to the skilled person that the impregnating liquid can be made to enter these actual fiber walls where it can act on the pectin in the fiber walls.

Claim 1 has been amended to positively recite the steps of the method. In addition, all of the claims have been revised to place them in a form more suited to U.S. practice. Thus, the European-style "characterized in that" language is no longer present, and the preferred embodiments are now the subject of separate dependent claims. No new matter is entered.

Unexpected advantages arise from the selection of pectinase, including selective weakening of a pectin-enriched region in the fiber walls, resulting in hydrolysis of the pectins which in turn results in a selective fiber separation. This feature is now recited in claim 1 and is supported by the originally filed application at, for example, page 4, line 10 onwards. Further advantages are limited loss of yield of less than about 1 %, which can be compared to a practically unlimited loss by use of hemicellulose/cellulose-decomposing enzymes, reduced shives content (see page 8, lines 3-4 and Table 1), improved optical properties (see page 2, lines 13-16; page 12, lines 1-3), and improved strength properties (see page 2, lines 13-16; page 9, lines 7-8).

Turning to the prior art rejections, there is nothing in Vaheri which would suggest to one of ordinary skill in the art that the above-listed advantages might be expected when selecting pectinase from the list of enzymes Vaheri. In fact, Vaheri leads the skilled artisan to the notion that the action and effect of pectinase could be expected to be the same as that of hemicellulase and cellulase, which is not correct.

Vaheri relates to enzymes for decomposition of hemicellulose and/or cellulose, in order to achieve a reduction in energy consumption in the production of mechanical pulp. The example given shows the efficiency of hemicellulase in reduction of refining energy (by about 20 %), in the treatment of a coarsely separated pulp. However, there is no suggestion of the advantages which have been discovered according to the present invention by the use of pectinase.

By way of background, pectin is a group of substances that do not belong to celluloses or hemicelluloses. If pectin remains in the pulp after the production, it may negatively affect the paper production, due to the latent acidic groups that will be dissolved in process water and interfere with the utilization of paper chemicals. There are many studies that aim at decomposing the pectin of a mechanical pulp, after refining, by way of for example enzymatic treatment.

One distinctive character of the pectin is that, despite its low content of about 1 % by weight, it predominantly exists in the layer between the fibre primary wall and the middle lamella. Hence, the basic concept of the present invention is to make use of the selectivity of the pectinase in order to decompose the pectin, and hence to achieve a local weakening in the fibre wall and, furthermore, a selective fibre separation in the mechanical defibration. A selective fibre separation will result in a lower energy

consumption and a more favorable development of pulp properties, as is shown in the examples of the present application.

The object of the treatment with pectinase is also different from what is taught by Vaheri, since Vaheri aims at decomposing hemicellulose and/or cellulose. The present invention also seeks to limit the loss of yield to the level at which decomposition of pectin occurs. Moreover, the treatment is typically conducted on chips before refining, which is different from a coarsely separated pulp as is shown in the example of Vaheri.

Although Vaheri states that pectinase can be used for the same purpose of reducing energy consumption and improving pulp properties, it has not been shown or discussed how to achieve such results. Vaheri regards pectinase as an example of a hydrolytic enzyme that decomposes cellulose and/or hemicellulose, in the same way as does hemicellulase in the example, and thereby pectinase is included in the same group that has been exemplified by hemicellulase. However, this is not a correct assumption with regard to the action of pectinase. If pectinase had actually be used by Vaheri, it would have been discovered that it does not at all decompose hemicellulose/cellulose. The specific action of pectinase on a limited amount of pectin in the wood, limits the loss of yield to a yield loss of less than about 1%, which is to be compared with a essentially unlimited loss upon use of hemicellulose/cellulose-decomposing enzymes.

As pectinase does not act on hemicellulose/cellulose, a person skilled in the art could not have predicted the advantages realized according to the present invention based on Vaheri.

The above-noted deficiencies of Vaheri are not cured by Bystedt. Bystedt describes how to treat wood pieces having a length in the fibre direction of at least 100

mm, in order to achieve a better pulp strength due to fibre separation. From Bystedt, the skilled person would understand that compression at at least 5 MPa has such an effect, but that the method is difficult to employ generally on chips that are of considerably smaller size and, moreover, are more or less randomly oriented at compression.

As noted earlier, the purpose of the compression treatment according to the present invention (with or without heat pre-treatment) is primarily to create pores and contact surfaces for the enzyme to enter into the chips, where the pectin is, and to react with the pectin, which is very different from what is described in Bystedt. What is unique about the presently claimed method is the combination of compression treatment with pectinase treatment in order to get the pectinase into the fibre wall for the biochemical reaction. There is nothing in Vaheri or Bystedt that would lead the skilled person to choose pectinase from the listed enzymes and to expect results that differ from those achieved by Vaheri in respect of better pulp quality and improved yield. Moreover, there is nothing in the combination of Vaheri and Bystedt that would lead the skilled person to expect the surprising effects that have been shown according to the present invention, as discussed above.

In light of the above, it is clear that the person of ordinary skill would not have been motivated to arrive at the presently claimed method based on the combined disclosures of Vaheri and Bystedt. Absent any such motivation, a *prima facie* case of obviousness has not be generated in this case. Withdrawal of the obviousness rejection based on the Vaheri and Bystedt is respectfully requested.

With regard to the remaining rejections, those rejections rely on the combination of Vaheri and Bystedt with further secondary art or on Vaheri alone. The remaining rejections are focused on dependent claims which incorporate the features of claim 1, which are patentable for the above discussed reasons. Claim 21 defines a novel and patentable product produced according to the method of the invention. In light of this, it is believed that all of the remaining anticipation and obviousness rejections should be withdrawn. Such action is respectfully requested.

Favorable action is awaited.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: _____
Leonard C. Mitchard
Reg. No. 29,009

LCM:lff
901 North Glebe Road, 11th Floor
Arlington, VA 22203-1808
Telephone: (703) 816-4000
Facsimile: (703) 816-4100